Possible migration front of gas-related fluid inferred from 3D-seismic data in the eastern Nankai Trough

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High resolution 3D seismic survey, 'Tokai-oki to Kumano-nada', was conducted for methane hydrate exploration in the eastern Nankai Trough by METI in 2002. Our study focuses on zigzag-shaped specific reflectors on BSR margins, which have been recognized by JOGMEC on the 3D data. We call the reflectors 'Foldback Reflectors (FBRs)' in this study. From the edge of BSR, the 1st FBR generally extends down to lower formation below the BSR crossing sedimentary horizons. The following FBRs (often the 2nd, sometimes 3rd and those of higher order) extend down from the edge of the last FBR forming bellows-like shape. The 1st FBR indicates normal polarity (antiphase of BSR), and the following FBRs change their polarities alternately. FBRs are mostly developed in the well-stratified formation but not in the area of frequent fractures and the area of major lateral lithological change. Each FBR and its respective surrounding strata tilt roughly in the same direction.

FBR generally corresponds to lateral seismic facies boundary between BSR distribution area and outside the BSR area. The formation beneath the BSR shows dimmed facies characterized by relatively low amplitude and lack of high frequency components in contrast to outside the BSR area of normal facies. Seismic velocity analysis (JOGMEC, personal communication) suggests that FBRs correspond to velocity boundaries, where the dimmed facies below the BSR coinsides with relatively low velocity. The polarities of FBRs are also consistent with such velocity changes. Such dimmed facies with low velocity and low amplitude anomaly suggests relation to gas components in the formation water. The lowest FBR does not cross major unconformities, which often exhibit negative polarity suggesting fluid migration from the lower unit. In this case, the lowest FBR which shows negative polarity and reaches the unconformity is to be merged to the negative reflection of the unconformity. In addition, high amplitude layers are sometimes recognized at foldbacks convex to the outside the BSR area. These high amplitude layers probably having higher permeability are interpreted as conduits of gas-related fluid from the BSR distribution side to the outside the BSR area. From these facts, FBR can be regarded as an important proxy indicating migration front of gas-related fluid. This study is supported by MH21, Research consortium for methane hydrate resources in Japan.